भारतीय मानक
Indian Standard

IS 16507 : 2017
(Reaffirmed 2022)

परिवहनीय गैस सिलिंडर कास्केड — विशिष्टि

Transportable Gas Cylinders Cascade — Specification

ICS 23.020.30

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भारतीय मानक ब्यूरो
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April 2017 **Price Group 5**

Gas Cylinders Sectional Committee, MED 16

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Gas Cylinders Sectional Committee had been approved by the Mechanical Engineering Division Council.

This standard specifies the requirements for the design, manufacture, inspection and testing of a transportable refillable seamless steel cylinder cascade subjected to the vibration, loads or handling withstanding rough handling including being dropped or toppled.

A cascade is a portable assembly which is designed for being routinely lifted or transported and which consists of a frame and two or more cylinders connected to a manifold by cylinder valves or fittings such that the cylinders are filled, transported and emptied without disassembly. Unless otherwise stated, individual cylinders within cascade should conform to applicable standards for single cylinder. This standard specifies the additional requirements that apply when individual cylinders are assembled into a cascade.

Assistance has been taken from OISD 179 'Safety requirements on compression, storage, handling and refuelling of natural gas for use in automotive sector'.

While implementing this standard, the manufacturer and the inspection agency shall ensure compliance with statutory regulations.

The relevant SI units and corresponding conversion factors are given below for guidance:

Pressure 1Pa (Pascal) = 1 N/m^2
1 kgf/mm^2 = 9.806 65 MPa

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

TRANSPORTABLE GAS CYLINDERS CASCADE — SPECIFICATION

1 SCOPE

This standard specifies the requirements for the design, manufacture, inspection and testing of a transportable refillable seamless steel cylinder cascade**.** It is applicable to cascades containing permanent compressed gases and mixtures there of excluding toxic gases and acetylene.

This standard does not apply to cascades in which cylinders are manifolded together in a support frame which is designed to be an integral part of a railway wagon or fixed to the ground as a customer storage vessel , for use in extreme environmental or operational conditions when additional and extraordinary requirements are imposed to maintain safety standards, reliability and performance (for example off shore cascades are a specific example) and cascade for gases dissolved in liquid under pressure.

Some special applications (for example electronics) require an alternative design approach. With the agreement of the inspection body, the manifold and its piping components may be designed and tested at a pressure which is appropriate to the service conditions.

Unless otherwise stated, individual cylinders within cascade shall have to conform to applicable standards for single cylinders. This standard specifies the additional requirements that apply when individual cylinders are assembled into a cascade. Cascades complying with this standard may be used for stationery application.

2 REFERENCES

The following standards contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
3224 : 2002	Valve fittings for compressed gas cylinders excluding liquefied petroleum gas (LPG) cylinders — Specification
4379 : 1981	Identification of contents of industrial gas cylinders (*first revision*)
5334 : 2014	Magnetic particle flaw detection of welds — Code of practice (*third revision*)
7241 : 1981	Glossary of terms used in gas cylinder technology (*first revision*)
7307 (Part 1) : 1974	Approval tests for welding procedures: Part 1 Fusion welding of steel
7310 (Part 1) : 1974	Approval tests for welders working to approved welding procedures — Part 1 Fusion welding of steel
7743 : 2006	Recommended practice for magnetic particle testing and inspection of steel forgings (*first revision*)
IS/ISO 11114-1	Transportable gas cylinders — Compatibility of cylinder and valve materials with gas contents : Part 1 Metallic materials
IS/ISO 11114-2	Transportable gas cylinders — Compatibility of cylinder and valve materials with gas contents : Part 2 Non-metallic materials
ISO 13585 : 2012	Brazing — Qualification test of brazers and brazing operators

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 7241 and the following shall apply:

3.1 Authorized Inspection Authority — Competent inspection authority mutually agreed by cascade manufacturer and buyer for the supervision of construction and testing of cascade.

3.2 Burst Pressure of Cascade Assembly — It is the lower of the design minimum burst pressure of the cylinder or the design minimum burst pressure of the manifold assembly.

3.3 Cascade — A cylinder cascade is a portable assembly which is designed for being routinely lifted or transported and which consists of a frame and two or more cylinders each of capacity up to and including 400 litre water capacity and with an aggregate capacity of not more than 15 000 litre water capacity connected to a manifold by cylinder valves or fittings such that the cylinders are filled, transported and emptied without disassembly.

NOTE — Subject to the permissible limits specified by the Road Transport Authority for the vehicles load and stability considerations under *Central Motor Vehicle Act*.

3.4 Cascade Test Pressure — Lower of test pressure of the cylinder or test pressure of manifold.

3.5 Compressed Gas — Compressed gas means permanent gas or gas mixture which in a closed gas cylinder exercises a pressure either exceeding 2.5 kgf/cm^2 absolute (1.5 kgf/cm^2 gauge) at +15ºC or a pressure exceeding 3 kgf/cm^2 absolute (2 kgf/cm^2 gauge) at +50ºC or both.

3.6 Cylinder Fitting — Device with no gas shut-off capability which serves as a method for connecting a cascade's manifold to its individual cylinder when cylinder valves are not fitted to the cylinders.

3.7 Cylinder Valve — Valve which is fitted into a cylinder and to which a manifold is connected in a cascade.

3.8 Filling Pressure — Pressure to which a cascade is filled at the time of filling.

3.9 Frame — Structural and non-structural members of a cascade which combine all other components together, whilst providing protection for the cascade's cylinders, valves and manifold and which enable the cascade to be transported.

3.10 Helium Test Gas — Leak testing gas mixture containing not less than 2 percent Helium.

3.11 Main Connection — Means of making a gas connection to a cascade.

3.12 Main Valve — Valve which is fitted to a cascade's manifold and used for the isolation of the cascade/individual bank.

3.13 Manifold — Arrangement of interconnected pipes for connecting a cascade's cylinder valves or cylinder fittings to the main valve(s) or main connection(s).

3.14 Manufacturer — Organization responsible for the design, manufacturing and testing of cascade.

3.15 Maximum Gross Weight — Sum of tare weight of the cascade and the weight of the maximum permissible gas filled.

3.16 Maximum Permissible Filling/Operating Pressure — Maximum pressure experienced by the cascade during filling or usage.

3.17 Proof Test Pressure of Manifold — Hydraulic pressure which demonstrates the structural integrity of the manifold piping assembly without accessories.

3.18 Sundry Items — Those parts other than cylinders, frame, manifold, cylinder valves, cylinder fittings and main connections which make up a complete cascade

NOTE — Sundry items typically include labels, cylinder neck rings, data plates, fasteners, clamps, dip tubes, pressure gauges, protective caps, etc.

3.19 Tare Weight — Weight of the cascade when empty of gas product.

3.20 Cylinder Test Pressure (P_h) — Test pressure means the internal pressure required for the hydrostatic test or the hydrostatic stretch test of the cylinder.

3.21 Toxic Gases — Gases which are known to be so toxic or corrosive to humans as to pose a hazard to health or are presumed to be toxic or corrosive to the humans because they have a LC_{50} value equal to or less than 5 000 ml/m^3 (ppm).

3.22 Working Pressure — Working pressure for permanent gas means the internal pressure of compressed gas in the cylinder at a uniform temperature of 15°C.

NOTE — All the pressures referred to in this standard are gauge pressures.

3.23 Bank of Cylinders — It is a sub group of cylinders manifolded together and isolated by independent main valve.

3.24 Stability Ratio — It is the ratio of height of center of gravity of filled cascade from the ground to the distance between the outermost contact points of tyres on load carrying axle when the cascade is placed on a vehicle.

3.25 Permanent Gas — Permanent gas means a gas whose critical temperature is below -10°C, that is to say a gas which cannot be liquefied under any pressure at a temperature above -10°C.

4 DESIGN

4.1 General

Unless stated to the contrary, standards applicable to individual elements shall apply to elements within the cascade.

All pressurised components shall be designed to operate in the temperature range of -20ºC to +65ºC. For use in extreme environment conditions, they shall be designed to withstand temperature conditions outside this range.

Cascades where gas is filled by weight shall not feature component parts which are demountable without the use of tools, with the exception of the main valve outlet protection cap.

Cylinders installed horizontally in a cascade shall be separated from another cylinder in the cascade by a distance not less than 30 mm.

4.2 Material

Materials for cylinders, valves and all parts which are in contact with the intended gas shall conform to IS/ISO 11114-1 and IS/ISO 11114-2 for compatibility. Material not specified in above standards may be used with approval from the statuary authority.

4.3 Frame

4.3.1 The frame structure shall securely retain all the components of the cascade and shall protect them from damage which might cause leakage. Such damage can be caused by vibration, impact loads or handling loads which can be expected in normal operation. The method of cylinder restraint shall prevent any vertical or horizontal movement or rotation of the cylinder. All cylinder displacement which would impose undue strain on the manifold shall be prevented. While lifting or handling of cascade , the structural members of the frame shall not show visible bend, buckle or distortion. The total assembly shall be capable of withstanding rough handling or mechanised handling.

4.3.1.1 No leakage of gas shall be caused during the lifting and handling of the cascade (*see* **4.3.3**).

4.3.2 While transporting the cascade, the vehicle shall be so selected that no part of the cascade protrudes outside the allowable limit of vehicle dimensions. Where required height barrier shall be provided on the cascade frame.

4.3.3 The frame structure shall include features designed for the handling and transportation of the cascade. Cascade may be lifted typically by fork-lift, lift-jack trolley or overhead crane. If the bundle is designed to be lifted by an overhead crane, lifting eyes shall be provided on the frame. In case when the frame is designed as permanently attached to the chasis of road vehicle, it shall be capable of lifting by crane without any distortion of the structural members and without causing any damage to the manifold.

The lifting eyes shall be designed to withstand a design load of 2 × maximum gross weight. Cascade with more than one lifting eye shall be designed such that a minimum sling leg angle (á) of 45° to the horizontal can be achieved during lifting using the lifting eyes (*see* Fig. 1).

Where four lifting eyes are used their design shall be such that they are strong enough to allow the cascade to be lifted by only two.

Where two or four lifting eyes are used, diametrically opposite lifting eyes shall be aligned with each other to allow for correct lifting using shackle pins.

Where a cascade is moved by fork-lift truck it shall feature two fork apertures on each side it is to be lifted from. The fork apertures shall be positioned symmetrically about the centre of gravity and their size shall be appropriate to the forks which are to be used to move the cascade. The fork apertures shall be designed such that the cascade cannot accidently disengage from the forks.

4.3.4 Frame structural members in the cascade shall be capable to withstand 4g impact (four times gravity) from any direction without any distortion. 4g static calculation of one complete assembled cascade with all cylinders mounted and filled with the gas shall be carried out.

4.3.5 The frame design shall ensure that there are no protrusions from the exterior frame structure which could cause hazards.

4.3.6 There shall be no features in which water, debris get accumulated to increase the tare weight of cascade filled by weight, or to cause corrosion.

4.3.7 The base of the cascade frame shall not buckle during normal operational conditions and shall facilitate the drainage of water and debris around the base of the cylinders.

4.3.8 The design shall ensure stability under normal operating conditions. Cascade shall not topple over when its resting face is inclined by 15^{o} to horizontal in any direction. Stability ratio shall not exceed one.

4.3.9 If the frame design includes any movable doors or covers then these shall be capable of being secured in position with latches, which shall not be capable of being dislodged by operational impact loads.

4.3.10 Access shall be maintained to all valves which need to be operated in normal service or in an emergency.

4.3.11 *Impact Protection*

There are three types of impact protection:

a) *Rear end protection* — An arrangement shall be fitted at the rear of the cascade to provide adequate protection to the rear pipe work and fittings to prevent accidental leakage of gas in the event of a rear impact. There shall be a clearance of atleast 100 mm between the arrangement and the rearmost

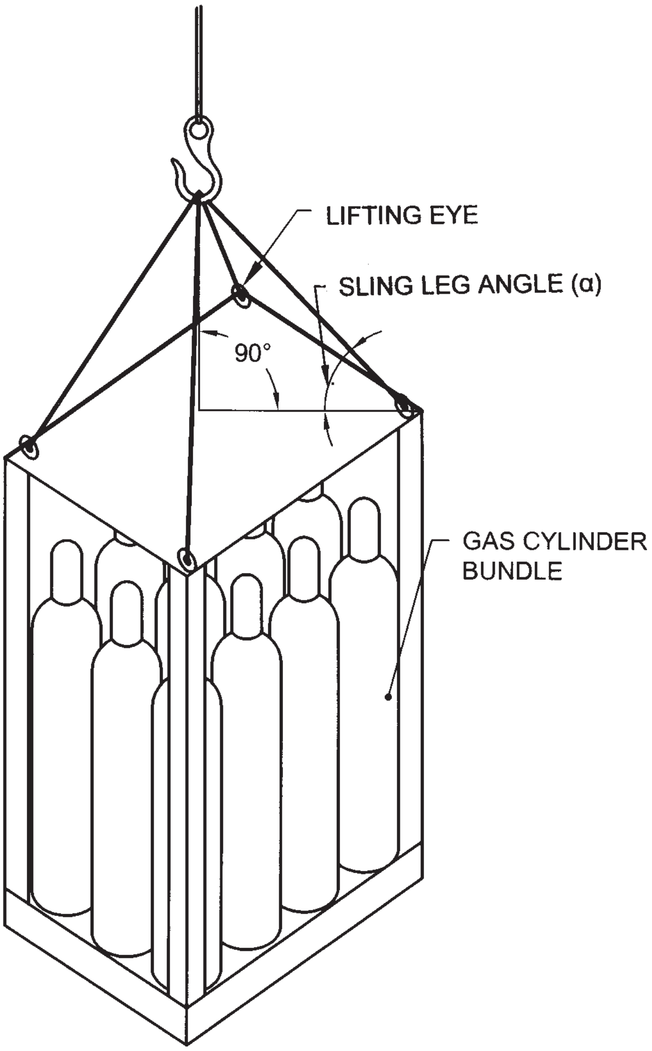

FIG. 1 MINIMUM SLING LEG ANGLE

point of the piping, fittings and valves under gas pressure during transport.

b) *Side and rollover protection* — Manifold shall be designed such that they are protected from impact in the event of a cascade rolling onto its side or upside down.

c) *Conspicuousness* — Florescent reflector tape paint shall be applied on the cascade frame to improve conspicuousness at night time.

4.4 Cylinders

Cylinders within a cascade shall be approved by the statuary authority suitable for the gas service. They shall all have the same nominal water capacity, test pressure and shall conform to the same Indian Standard covering individual cylinders.

4.5 Cylinder Valve Fittings

4.5.1 Cylinder valve fittings shall be determined by the gas product within the cascade and operational requirements.

4.5.2 When cylinder valves are fitted, their outlet connections shall conform to IS 3224 or as approved by statutory authority.

4.5.3 Cylinder valves fittings shall be compatible with the neck thread of the cylinder.

4.6 Manifold

4.6.1 The manifold shall be designed and constructed so as to avoid the risk of damage due to thermal expansion and contraction, mechanical shock and vibration and compatible with the gas and the pressure for which the cascade is intended.

4.6.2 Where the manifold is made of metal, the necessary flexibility shall be achieved by the use of bends or coils. Flexible hoses or non-metallic pipe work shall only be used as part of the fixed pipe work on the cascade after trials have proved their acceptability, and the length of such hoses and pipe work shall be kept to a minimum.

4.6.3 The manifold shall be designed to be capable of withstand minimum hydraulic pressure requirements of the cylinders.

4.6.4 The maximum stress of the manifold arrangement at the 1.5 x working pressure shall not exceed 75 percent of the guaranteed yield strength of the material.

4.6.5 For compressed gases, the manifold shall be designed in such a way that the burst pressure shall be greater than or equal to 2 times the working pressure of the cylinders in the cascade.

4.6.6 No metal parts of the cascade shall bear against other metal parts/components in the cascade except at cylinder valve/fitting interfaces or at defined attachment points to the frame. The securing/gripping of the cylinders in position shall be done by using suitable spacers. Contact between dissimilar metals which could result in damage by galvanic action shall be avoided.

4.6.7 When threaded joints are used, the tubing thickness shall be suitably increased to compensate for reduced thickness at threaded areas.

4.6.8 In the case of flammable gases, electrical continuity shall be maintained throughout the pipe work system and between the pipe work, the elements and their supports. An earthing connection shall be provided for use during loading and discharging and its position shall be clearly indicated and be readily accessible. Flexible hoses shall have electrical continuity with a resistance not exceeding 10 Ω.

4.6.9 A means of immobilising the cascade vehicle whilst it is connected for filling or emptying shall be provided.

4.6.10 Reclosing type Safety Relief Valve (SRV) shall be provided at appropriate place in the manifold. The SRV should release the pressure 20 percent above the cylinder working pressure. The discharge of the SRV vent shall be provided at the highest point of the cascade and flame arrestors shall also be provided in case of flammable gases. Common header shall be provided for pressure relief devises (PRD). Vent manifolds shall be provided for the cylinder valves provided with PRD’s.

4.6.11 Pressure gauge provided in the manifold shall be located at such a place that it is easily readable and shall have isolation valve. Pressure range shall be at least 1.5 times the cylinder working pressure.

4.7 Assembled Cascade

The assembled cascade shall be designed so that it withstands the following statically applied loads:

4.7.1 Frame structural members for individual cylinder having more than 250 litre water capacity for Jumbo Cylinder Cascade, permissible stress calculations shall be based on :

a) 2 × the maximum gross weight in all horizontal directions and vertically downwards; and
b) 1 × the maximum gross weight in the vertical direction upwards.

In case when the cascade is permanently attached to the road vehicle, the frame design shall include chasis member of the road vehicle for structural calculations. This shall be checked by carrying out structural analysis.

4.7.2 Frame structural members for individual cylinder up to 250 litre in the cascade shall be capable of withstanding 4g impact (four times gravity) from any direction without any distortion.

In case, when the cascade is permanently attached to the road vehicle, the frame design shall include chasis member of the road vehicle for structural calculations

This shall be checked by carrying out structural calculations as mentioned in **4.3.4** and submission of the same to inspection authority.

5 MANUFACTURING

Cascade shall be manufactured in accordance with the design criteria listed in **4**. Where metal joints are made the following conditions shall be observed:

a) Welding procedure in accordance with IS 7307 (Part 1).
b) Approved welders in accordance with IS 7310 (Part 1).
c) Approved brazers in accordance with ISO 13585.

6 IDENTIFICATION

6.1 Colour Coding

The individual cylinder in the cascade shall be painted as per IS 4379 according to gas application. The colour of a cascade frame shall carry no significance with respect to the gas contained in the cascade cylinders.

6.2 Cascade Identification for Filling

6.2.1 *General*

In addition to the information on individual cylinders in accordance with relevant standard, the information specified in **6.2.2** shall be clearly identified on a corrosion resistant plate permanently fixed on the outside of the cascade. The characters in marking shall be at least 6 mm in height.

6.2.2 *Cascade Marking*

Each cascade shall be permanently stamped with the following:

a) Identification of the cascade manufacturer,
b) Cascade owner's name,
c) Serial number assigned by the cascade manufacturer,
d) In addition, each frame shall include a unique identification number which shall be permanently marked. This number may be independent from the cascade serial number,
e) Cylinder working pressure, in kgf/cm^2 or Bar,
f) Cylinder test pressure in kgf/cm^2 or Bar,
g) Cylinder water capacity, in litre,
h) Cascade Total water capacity, in litre,
j) Cylinder serial numbers in the cascade,
k) Cascade maximum gross weight with gas, in kg,
m) Gas application,
n) Number of this Indian Standard,
p) Inspector's official mark,
q) Date of inspection, such as 03/2012 for March 2012, and
r) Next due date for cylinders restesting.

6.2.3 BIS CERTIFICATION MARKING

Each cascade may also be marked with the Standard Mark.

6.2.3.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which a license for the use of the Standard Mark may be granted to the manufacturers or the producers may be obtained from the Bureau of Indian Standards.

6.3 Other Useful Information

The following information is useful in practice and may be marked on the cascade in addition to the information given in **6.2**:

a) Maximum gross weight of the cascade, in kilograms, which should be visible from all directions from which lifting can be performed. The minimum height of the lettering shall be 30 mm.
b) Other critical operating instructions, for example closure of individual cylinder valves in transit when this is required.
c) Name or identification of the owner.

7 TESTING AND INSPECTION

7.1 Test and Inspection at Time of Manufacture

7.1.1 *Frame*

One frame of a design shall be proof load tested to 2 x the maximum gross weight as follows:

a) Lifting eyes shall be tested for crack defects in accordance with IS 7743 prior to coating of the frame;
b) All primary structural welded joints shall be subjected to crack detection in accordance with IS 5334, prior to coating of the frame; and
c) The frame shall be loaded with the requisite weight in the form of empty cylinders or any other steel/concrete/water containers and then lifted with the crane.

The frame shall be visually inspected to ensure that there is no deviation from the design drawings and that there is full and free movement of panels and covers, where applicable.

If the tested frame fails one of the above tests, all the frames of the corresponding lot shall be tested. All defective frames shall be either scrapped or repaired and then subjected to test again. During manufacture, all frames shall be tested as per (**a)** and (**b**).

7.1.2 *Manifold*

Each manifold shall conform to **4.6**. The manifold shall be subjected to a hydraulic proof test pressure with a pressure specified in **4.6.3**.

All manifolds that fail this test shall be either scrapped or repaired and then tested again.

NOTE — In case of manifold with compression fittings, this test need not be performed.

7.1.3 *Cascade*

7.1.3.1 *General*

Leak testing shall be performed using Nitrogen, compressed air or gas mixture containing more than 2 percent of helium.

7.1.3.2 *Assembly leak test*

Under the responsibility of the cascade manufacturer, the completed cascade shall be leak tested at a pressure 1.1 times the working pressure to check the integrity of all joints and gas connections.

7.1.3.3 *First fill leak test*

The completed cascade shall be tested for leaks with the gas for which the cascade is manufactured, at the filling pressure, using appropriate methods and acceptance criteria as agreed to between the cascade manufacturer and the user. This operation can be performed under the supervision of the cascade manufacturer or by the filling centre during the first fill after assembly as a part of the ‘inspection at time of filling’.

NOTE — Depending on the gas type, more sophisticated leak test methods might be suitable.

7.2 Periodic Testing

7.2.1 Owner of the cascade shall ensure that cascade cylinders for which prescribed periodic re-test has become due shall be retested.

7.2.2 At the time of retest of cylinders, cascade frame, manifolding etc. shall also be subjected to test and inspection. Defective parts shall be replaced or repaired.

8 DOCUMENTATION

8.1 Records of the components used to produce a cascade and where the cascade was assembled and tested shall be maintained for every new cascade. The record shall be maintained by both the cascade manufacturer and the owner of the cascade. The records shall contain the following information:

a) Reference to this standard;
b) Unique serial number of the cascade;
c) Unique serial number of the frame;
d) Component used for making the manifold;
e) Gas type(s) for which the cascade is intended;
f) Cascade manifold test pressure (in accordance with the test pressure of the cylinders);
g) Cylinder serial numbers and their loading positions in the cascade frame;
h) Name and address of the cascade manufacturer;
j) Date of manufacture of the cascade (in the format MM / YYYY); and
k) Cylinders retest date

8.2 Original test records and/or certificates of individual components or batches of components shall be maintained by the cascade manufacturer such that they can be cross-referenced to individual cascade records.

8.3 All records shall be maintained at least as long as the cascade and / or components exist.

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Gas Cylinders Sectional Committee, MED 16

Organization	*Representative(s)*
Petroleum and Explosive Safety Organization, Nagpur	Shri T. R. Thomas (***Chairman***) Shri Ashendra Singh (*Alternate*)
All India Industrial Gases Manufacturers Association, New Delhi	Shri Saket Tiku Shrimati Veena Peter (*Alternate*)
Ashok Leyland Limited, Chennai	Shri M. Ravi Shri S. Arun (*Alternate*)
Bharat Petroleum Corporation Ltd, Mumbai	Shri Vishnu D. Sonawane Shri A. Prabhakar (*Alternate*)
Bharat Pumps and Compressors Ltd, Allahabad	Shri Mohan Kumar Shri P. G. Choudhury (*Alternate*)
BOC India Ltd, Kolkata	Shri Ramana Vutukuru Shri Pradeep (*Alternate*)
Everest Kanto Cylinder Ltd, Mumbai	Shri P. M. Samvatsar Shri A. K. Khamkar (*Alternate* I) Shri H. D. Khatri (*Alternate* II)
GSPC Gas Company Ltd, Gandhinagar	Shri K. S. R. Prasad
Hindustan Petroleum Corporation Ltd, Mumbai	Shri S. Nandi Shri P. N. Kanth (*Alternate*)
Indian Oil Corporation Ltd, Mumbai	Shri Ashutosh Tiwari Shri S. M. Rambhal (*Alternate*)
Indraprastha Gas Limited, Delhi	Shri Praveen K. Pandey Shri Alok Sharma (*Alternate*)
International Industrial Gases Ltd, Kolkata	Shri Devendra K. Garg Shri Nikhilesh K. Garg (*Alternate*)
Kabsons Gas Equipments Ltd, Hyderabad	Shri Satish Kabra Shri Kunal Kabra (*Alternate*)
Kosan Industries Ltd, Mumbai/Surat	Shri S. K. Dey Shri S. B. Bomal (*Alternate*)
LPG Equipment Research Centre, Bangalore	Shri P. Krishnan Kutty Dr A. Krishna (*Alternate*)
Luxfer Uttam India Pvt Ltd, Faridabad	Shri Karan Bhatia Shri Sandeep Bhasin (*Alternate*)
Mahanagar Gas Limited, Mumbai	Shri S. Murali Shri Arun Nayak (*Alternate*)
Maruti Koatsu Cylinders Ltd, Mumbai	Shri Nitin J. Thakkar Shri A. S. Saran (*Alternate*)
Ministry of Defence (DGQA), Pune	Shri J. P. Tiwari, JASG Shri K. Sudhakaran (*Alternate*)
Research & Development Estt (Engineers), Pune	Shri P. K. Chattopadhyay Shri A. Basu (*Alternate*)
Sakha Engineers Pvt Ltd, New Delhi	Shri Amarjit S. Kohli
SICGIL India Ltd, Chennai	Shri Farooque Dadabhoy Shri R. Padmanaban (*Alternate*)
Society of Indian Automobile Manufacturers (SIAM), New Delhi	Shri K. K. Gandhi Shri Amit Kumar (*Alternate*)
Steel Authority of India Ltd, Ranchi	Shri Debashis Karmakar Dr B. K. Jha (*Alternate*)
Supreme Cylinders Ltd, Delhi	Shri M. L. Fathepuria
Tata Motors Ltd, Pune	Shri P. K. Banerjee Shri Amul Verma (*Alternate*)

Organization	*Representative(s)*
Tekno Valves, Kolkata	Shri Y. K. Behani Shri R. Behani (*Alternate*)
The Automotive Research Association of India, Pune	Dr S. S. Thipse Shri S. D. Rairikar (*Alternate*)
Trans Valves (India) Pvt Ltd, Hyderabad	Shri A. K. Jain Shri P. K. Mathor (*Alternate*)
Vanaz Engineers Ltd, Pune	Shri K. P. Velayudhan Shri S. J. Vispute (*Alternate*)
BIS Directorate General	Shri T. V. Singh, Scientist 'F' and Head (MED) [Representing Director General (*Ex-officio*)]

Member Secretary

Shri Chandan Gupta

Scientist 'B' (MED), BIS

Dissolved Acetylene Cylinders, Generators, Acetylene Pipe Lines and High Pressure Gas Cylinders Subcommittee, MED 16 : 3

Organization	*Representative(s)*
BOC India Limited, Kolkata	Shri Vutukuru Ramana (***Convener***)
Al-Can Exports Private Limited, Distt Thane	Shri Vijay K. Parikh Shri D. C. Dave (*Alternate*)
All India Industrial Gases Manufacturers Association, New Delhi	Shri Saket Tiku Shrimati Veena Peter (*Alternate*)
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Hindalo Industries Limited, Mumbai	Shri Subhankar Gupta Shri S. Devdoss (*Alternate*)
Hindustan Petroleum Corporation Limited, Mumbai	Shri M. Selvakumar Shri Alok Kumar Gupta (*Alternate*)
Indian Oil Corporation Ltd, Mumbai	Shri Ashutosh Tiwari Shri S. M. Rambhal (*Alternate*)
Indraprastha Gas Limited, New Delhi	Shri Praveen K. Pandey Shri Ujwal Bhandari (*Alternate*)
International Industrial Gases Limited, Howrah	Shri D. K. Garg Shri N. K. Garg (*Alternate*)
Jai Maruti Gas Cylinders Gases Limited, Gwalior	Shri Ashok K. Nigam Shri Manu Kumar Nigam (*Alternate*)
KVK Corporation, Mumbai	Shri R. Chandgothia Shri V. Chandgothia (*Alternate*)
Maruti Koatsu Cylinders Limited, Mumbai	Shri Nitin J. Thakkar Shri A. S. Saran (*Alternate*)
Ministry of Defence (DGQA), Pune	Shri J. P. Tiwari Shri K. Sudhakaran (*Alternate*)
Petroleum and Explosive Safety Organization, Nagpur	Shri T. R. Thomas Shri Ashendra Singh (*Alternate*)
Rama Cylinders Private Limited, Mumbai	Shri Sanjay R. Mande Shri Pramod W Sangwai (*Alternate*)
Sahuwala High Pressure Cylinder (P) Limited,	Shri T. Subramanian Visakhapatnam Shri Evny Muralidhar (*Alternate*)
SICGIL India Limited, Chennai	Shri S Maragathvel Shri Nauzer. F Dadabhoy (*Alternate*)

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Tekno Valves, Kolkata	Shri Y. K. Behani Shri R. Behani (*Alternate*)
The Automotive Research Association of India, Pune	Shri M. K. Choudhari Dr S. S. Thipse (*Alternate*)

Bureau of Indian Standards

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